REMARKS

In the Office Action, claims 1-6, 8, 10-27, 31 and 32 were rejected. Claims 7, 9, 28-30 and 33-39 were objected to. By the present Response, claims 1, 3, and 27 are amended. Claims 10-17, 22, 23 and 28 are canceled. Upon entry of the amendments, claims 1-9, 18-21, 24-27 and 29-39 will remain pending in the present patent application. Reconsideration and allowance of all pending claims are requested.

Objection to the Drawings and Specification

The drawings were objected to because Fig. 4 and Fig. 5 include reference character 410 that was not mentioned in the description. The specification was in turn, objected to because the specification did not address numeral 410 in Fig. 4 and Fig. 5. Paragraph 47 of the specification is amended to obviate the objections raised in the Office Action. Review and acceptance of the replacement paragraph are requested.

The abstract of the disclosure was objected to because it contained the title and legal phraseology, such as the term "said". The title has been deleted and the abstract has been amended to replace every occurrence of "said" by "the". Review and acceptance of the abstract are requested.

Claim objections due to informalities

In the Office Action, claims 1-4 are objected to due to certain informalities. Independent claims 1 and 3 have been amended to obviate the objections raised in the Office Action. In particular, the preamble in each of claims 1 and 3 is amended to recite "having two or more energy storage banks". Claims 2 and claim 4 were objected to because of their dependency on objected claims 1 and 3 respectively. The Applicants believe that these objections are obviated by the amendments of independent claims 1 and 3.

Claim 17 was objected to because claim 17 depended from itself. Claim 17 has been canceled in this amendment.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, 5, 6 and 8 were rejected under 35 U.S.C. § 102(b) as being anticipated by Ukita et al. (U.S. Patent No. 5,905,360, hereinafter "Ukita").

Claims 3, 18 and 19 were rejected under 35 U.S.C. § 102(b) as being anticipated by Hoffman, Jr. et al. (U.S. Patent No. 5,869,950, hereinafter "Hoffman").

Claims 10, 13, 14, 16 and 17 were rejected under 35 U.S.C. § 102(e) as being anticipated by Ovshinsky et al. (U.S. Patent Application Publication 2003/0129459, hereinafter "Ovshinsky").

Claims 22 and 24-26 were rejected under 35 U.S.C. § 102(b) as being anticipated by Dunn et al. (U.S. Patent No. 6,239,579, hereinafter "Dunn").

Claims 27 and 31 were rejected under 35 U.S.C. § 102(b) as being anticipated by Clegg et al. (U.S. Patent No. 5,394,089, hereinafter "Clegg").

Of the pending claims, claims 1, 3, 5, 18, 24, 27 and 31 are independent. Claim 27 has been amended. All of the pending claims are believed to be patentable as cited below.

Independent Claim 1.

Claim 1 recites, *inter alia*, a method for equalizing a storage parameter for a vehicle energy storage system having two or more energy storage banks. The method includes identifying a quiescent period of operation for the vehicle and determining whether the value of a defined storage quantity for a first energy storage bank differs from

the value of the defined storage quantity for a second energy storage bank by *a threshold amount*.

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. Claim 1 is clearly patentable over Ukita at least because Ukita fails to teach determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by *a threshold amount*.

Ukita fails to teach a method for determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by a threshold amount.

The Examiner suggested that Ukita teaches this feature of the invention. The Examiner cited a passage from Ukita at column 9, lines 46-53, in support of the rejection:

> [T]o eliminate the unbalance, charges are forcedly transferred from the battery block A in a high SOC to the battery block B in a low SOC (hereinafter referred to as "balancing charge-and-discharge") through the bidirectional boosting converter 44 until SOCs of both battery blocks become nearly equal (namely, until a significant difference of SOCs between the two battery blocks disappears), as shown by the second A?Bs in FIGS. 5 and 6.

Neither the cited lines nor the remainder of Ukita support the Examiner's position, however. Applicants respectfully submit that Ukita teaches considering a *significant difference in state of charge* between the two battery blocks as opposed to *a threshold amount*. The threshold comparison is elaborated in the present application, in paragraph 35, lines 1-15:

> If, however, a quiescent point is determined, the ESS controller proceeds to decision block 206, at which it is determined whether a defined storage quantity for bank 1 (X1) is less than the storage quantity for bank 2 (X2) by a defined threshold difference (T2).

> The compared storage quantity may be, for example: stored energy (kilowatt-hours), so as to ensure each bank has the same amount of energy available to deliver; relative stored energy (stored energy/rated energy), so as to ensure each bank has same amount of relative amount of energy to deliver and the same relative capacity available to accept more energy; stored energy minus rating (kilowatt-hours), so as to ensure each bank has the same available capacity to accept energy; stored charge (ampere-hours), so as to ensure each bank has the same amount of charge available to deliver; relative stored charge (stored charge/rated stored charge), so as to ensure each bank has the same relative amount of charge to deliver and the same relative capacity available to accept more charge; and stored charge minus rating (ampere-hours), so as to ensure each bank has the same available capacity to accept charge.

By contrast, in Ukita, the condition when charges are forcedly transferred is the presence of a significant difference of states of charge between the two battery blocks. The method defined by claim 1, on the other hand, relies upon determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by *a threshold amount*. The stored quantity may be, for example, stored energy (kilowatt-hours), relative stored energy (stored energy/rated energy), stored energy minus rating (kilowatt-hours), stored charge (ampere-hours), relative stored charge (stored charge/rated stored charge), or stored charge minus rating (ampere-hours).

Moreover, the claimed *threshold amount* comes into play before the actual transfer of charge happens and determines the direction of flow of the charge by determining which battery will gain charge and which battery will receive charge as is elaborated in the application at paragraph 36, lines 1-8:

> Regardless of the specific compared storage quantity, if X1 is less than X2 by at least the threshold difference T2, then the ESS controller will cause a discharge from bank 2 into bank 1, as shown in block 208. If this is not the case, then the ESS controller will

> check for the reverse condition at block 210 (i.e., whether X2 is less than X1 by at least T2). If so, the ESS controller discharges from bank 1 into bank 2, as shown at block 212. If the compared quantity differential in either case is not greater than T2, then no action is taken, even in quiescent periods, as shown at block 214.

Because Ukita fails to teach comparison to "a threshold amount," Ukita cannot anticipate independent claim 1. Thus, it is respectfully requested that the rejection of claim 1 under 35 U.S.C 102(b) be withdrawn.

Independent Claim 3.

Claim 3 recites a method for equalizing a storage parameter for a vehicle energy storage system having two or more energy storage banks. The method includes identifying a quiescent period of operation for the vehicle and determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by *a threshold amount.*

Hoffman fails to teach a method for determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by a threshold amount.

The Examiner suggested that Hoffman teaches determining whether the value of a defined storage quantity for a first energy storage bank differs from the value of the defined storage quantity for a second energy storage bank by *a threshold amount.* The Examiner cited column 2, lines 13-17 and 18-24 in support of the rejection.

These passages read:

> The sensed module voltages are stored, at least temporarily, to thereby produce stored sensed module voltages. At least some of the voltages are sorted into at least one ordered ranking. In a preferred method, there are two ordered rankings.

* * *

> At least one of the modules which has a stored sensed voltage near the maximum of the ranking is selected from the ordered ranking, to thereby identify a high module. Preferably, the selected module has the highest sensed voltage. Another one of the modules, which has a stored sensed voltage near the minimum of the ranking is selected from the at least one ordered ranking, to thereby identify a low module.

The cited lines, and indeed the remainder of Hoffman do not support the Examiner's position, however. Applicants respectfully submit that Hoffman teaches an ordered ranking for sorting stored sensed voltages as opposed to *a threshold amount of a stored quantity*. The threshold is elaborated in the application as discussed above.

The ordered ranking method as disclosed by Hoffman is based on *sorting* stored sensed *voltages*. The method defined by claim 3, on the other hand, relies on determining whether the *value of a defined storage quantity* for a first energy storage bank differs from the *value of the defined storage quantity* for a second energy storage bank by *a threshold amount*.

Because Hoffman teaches an ordered ranking method and not comparisons based upon reference to "a threshold amount", Hoffman cannot anticipate independent claim 3. Thus, it is respectfully requested that the rejection of claim 3 under 35 U.S.C 102(b) be withdrawn.

<u>Independent Claim 5.</u>

Claim 5 recites, *inter alia*, a method for resetting a state of charge (SOC) calculation for a designated energy storage bank of an energy storage system of a vehicle. The method includes maintaining the designated energy storage bank at a *predetermined high terminal voltage for a specified period of time.*

Ukita fails to teach a method for maintaining the designated energy storage bank at a *predetermined high terminal voltage for a specified period of time.*

The Examiner suggested that Ukita teaches maintaining the designated energy storage bank at a *predetermined high terminal voltage for a specified period of time*. The Examiner cited a passage from column 2, lines 62-64 of Ukita in support of the rejection.

The cited passage reads:

> . . . between battery blocks over a predetermined level, or an excess of elapsed time after the last equalizing charge or refreshing discharge over predetermined time.

Neither the cited lines from Ukita, nor the remainder of the reference, supports the Examiner's position, however. Applicants respectfully submit that Ukita teaches an executing condition that is an excess of the voltage unbalance between batteries or between battery blocks over a predetermined level, or an excess of elapsed time after the last equalizing charge or refreshing discharge over predetermined time. This is not equivalent to maintaining a battery at a *predetermined high terminal voltage for a specified period of time*.

The predetermined high terminal voltage is elaborated in the application in paragraph 40, lines 1-10:

> As stated previously, the ESS state of charge is fairly difficult to determine for batteries. Accordingly, the SOC calculation may be reset so as to recover a more accurate battery state. In a conventional SOC calculation procedure, the battery is discharged to a fully discharged condition, and *thereafter charged to a fully charged condition and maintained at a predetermined high terminal voltage for a specified time while charging continues at a low current level*. At this point, the battery is defined to be completely charged and the SOC measurement is typically set to the known SOC capacity at this point. However, such an SOC calculation reset has heretofore been limited to circumstances

> where the OHV is not in operation (e.g., as during maintenance periods or when parked/garaged).

The excess voltage unbalance between batteries or between battery blocks over a predetermined level, or an excess of elapsed time after the last equalizing charge or refreshing discharge over predetermined time, as disclosed by Ukita, is an executing condition that acts as a *potential motive force for impending charge transfer* between two batteries. The method set forth in claim 5, on the other hand, entails maintaining the designated energy storage bank at a predetermined high terminal voltage for a specified period of time *after* the battery is fully charged or discharged.

Because Ukita fails to teach at least maintaining a battery bank at a "predetermined high terminal voltage for a specified period of time", Ukita cannot anticipate independent claim 5. Thus, it is respectfully requested that the rejection of claim 5 under 35 U.S.C 102(b) be withdrawn.

Independent Claim 18.

Claim 18 recites, *inter alia*, a method for generating an energy storage control parameter for a vehicle energy storage system. The method includes receiving energy storage electrical property information and *estimating*, from the energy storage electrical property information, a *storage bank temperature*.

Hoffman fails to teach a method for *estimating*, from the energy storage electrical property information, a *storage bank temperature*.

The Examiner suggested that Hoffman teaches *estimating*, from the energy storage electrical property information, a *storage bank temperature*. The Examiner cited a passage at column 16, line 63 of Hoffman in support of the rejection:

> . . . other criteria may be used to determine the charge state, such criteria including voltage, internal impedance, or module temperature.

Neither the cited line from Hoffman nor the rest of the reference supports the Examiner's position, however. Applicants respectfully submit that Hoffman teaches a method of determination of the full-charge and partially-charged states using criteria such as voltage, internal impedance, or module temperature. Hoffman does not, however, estimate, from the energy storage electrical property information, a storage bank temperature.

The storage bank temperature estimation is elaborated in the present application in paragraph 47, lines 1-9.

> Figure 4 illustrates a first implementation of the temperature estimation function in greater detail. As is shown, a storage bank temperature(s) estimator 400 (which may be directly included within the ESS controller) has a plurality of inputs thereto such as, for example, an energy storage power dissipation variable generated by a storage bank heat generation estimator 402, and an energy storage coolant flow variable generated by either a storage bank coolant flow measurement or estimator 404. Where measurement signals 406 are used in this regard, they may include energy storage cooling airflow, coolant fan or pump current, or coolant fan or pump power measurements, for example.

In fact, determination of the full-charge and partially-charged states using module temperature as disclosed by Hoffman is in exactly opposite of estimating, from the energy storage electrical property information, a storage bank temperature, recited in claim 18.

Because Hoffman does not teach storage bank temperature estimation, Hoffman cannot anticipate independent claim 18. Thus, it is respectfully requested that the rejection of claim 18 under 35 U.S.C 102(b) be withdrawn.

Independent Claim 24.

Claim 24 recites, *inter alia*, a method for controlling the operating range of one or more energy storage banks in a vehicle energy storage system. The method includes determining a point at which the energy storage bank has reached a *threshold value* with respect to an end of life condition.

Dunn fails to teach a method for determining a point at which the energy storage bank has reached a threshold value with respect to an end of life condition.

The Examiner suggested that Dunn teaches the method for determining a point at which the energy storage bank has reached a *threshold value* with respect to an *end of life* condition. The Examiner cited column 3, lines 15-16, and lines 7-13 of the abstract of Dunn in support of the rejection:

> . . . determining whether said useful capacity meets a predefined threshold for useful capacity.
>
> * * *
>
> A battery module whose useful capacity falls below a predefined threshold may be connected to a battery charger for replenishment and then electrically realigned with the remaining modules in the pack for continued operation.

Dunn does not support the Examiner's position, however. Applicants respectfully submit that Dunn teaches a method of determining whether the useful capacity of a battery meets a predefined threshold for useful capacity, but not determining a point at which the energy storage bank has reached a *threshold value* with respect to an *end of life* condition.

The *threshold value* with respect to an *end of life* condition is elaborated in present application in paragraph 53, lines 1-13:

> The end of life (EOL) of an energy storage systems is determined when the system no longer meets its performance requirements. For example, the EOL of a particular storage system may be defined when the usable stored energy capacity falls to 80% of the nominal value, or when the effective series resistance of the system rises to an unacceptably high value. In any case, this loss of performance is due to incremental damage that an energy storage bank sustains during each operational cycle of the storage bank, such that as the energy storage ages, its performance progressively reduces. Moreover, when it is attempted to charge or discharge an energy storage system with more energy than its capacity at that time, the loss of life is much accelerated. Accordingly, when an energy storage system is close to the end of its life and its operating cycle occasionally covers a high swing in the stored energy, it is more and more likely to be operated outside its now-reduced capacity range, with much higher likelihood of accelerated loss of the remaining life.

The method for determining whether the useful capacity of a battery meets a predefined threshold for useful capacity as disclosed by Dunn relates to *capacity* of a battery. The method defined in claim 24, on the other hand, relates to a *threshold value* with respect to *life* of a battery.

Because Dunn teaches a threshold for useful capacity and not "*threshold value* with respect to an *end of life* condition", Dunn cannot anticipate independent claim 24. Thus, it is respectfully requested that the rejection of claim 24 under 35 U.S.C 102(b) be withdrawn.

Independent Claim 27.

Claim 27 recites, *inter alia*, a method for controlling one or more energy storage banks in a vehicle energy storage system. Claim 27 has been amended by adding subject matter of claim 28, indicated as allowable. Claim 28 has been canceled. Claim 27 is therefore in condition for allowance.

Independent Claim 31.

Claim 31 recites, *inter alia*, a method for characterizing and projecting remaining cycle life for vehicle storage battery. The method includes projecting a *remaining cycle life* for the vehicle storage battery.

Clegg fails to teach a method for projecting a *remaining cycle life* for the vehicle storage battery.

The Examiner suggested that Clegg teaches the method for projecting a *remaining cycle life* for the vehicle storage battery. The Examiner cited passages at column 6, lines 30-37, and lines 7-9 of this abstract of Clegg in support of the rejection:

> The result from each charge/discharge cycle is integrated into a continuous store, the "historical charge efficiency". The system therefore "learns" the charging efficiency of the battery, load and charging unit.
>
> Logging of previous recharge rates, times and efficiencies allow the system to indicate the predicted recharge time required to return the battery to a charged state.
>
> * * *
>
> The recharging efficiency is also evaluated, stored and updated on each charge/discharge cycle so that ageing of the battery (9) is monitored.

Clegg does not support the Examiner's position, however. Applicants respectfully submit that Clegg teaches a method of indicating predicted recharge time required to

return a battery to a charged state, as opposed to projecting a *remaining cycle life* for the vehicle storage battery.

Projecting the *remaining cycle life* with respect to a battery is elaborated in the present application at paragraph 53, lines 1-13:

> Moreover, the energy rating of the battery is typically the total energy stored in the battery, not the useable energy. In an electric vehicle application, the lower limit for the SOC is typically somewhere around 20% of the total charge, or stated another way, around 80% of the Depth of Discharge (DOD) of the battery. Thus in the electric vehicle application, the useable energy is typically around 80% of the battery's total energy. Accordingly, the battery cycle life for an electric vehicle battery is often reported to be a number of 0 – 80% DOD cycles, after which point the available battery energy is reduced by 20% from the battery's original energy rating. Accordingly, at the battery's end of life, the electric vehicle will experience a 20% decrease in range.

The method for indicating predicted recharge time required to return a battery to a charged state as disclosed by Clegg relates to *remaining capacity* and recharge time required to return a battery to a charged state. The method set forth in claim 31, on the other hand, relates to a *remaining cycle life* of a battery.

Because Clegg teaches a recharge time required to return a battery to a charged state and not "*remaining cycle life*", Clegg cannot anticipate independent claim 31. Thus, it is respectfully requested that the rejection of claim 31 under 35 U.S.C 102(b) be withdrawn.

Rejections Under 35 U.S.C. § 103(a)

The dependent claims were all rejected in view of various combinations of references. The secondary references have been reviewed, and do not obviate the

deficiencies of the primary references discussed above. Accordingly, all dependent claims are believed patentable both by virtue of their dependency from an allowable base claim, and for the subject matter they separately recite. Their reconsideration is requested.

Conclusion

In view of the remarks and amendments set forth above, Applicants respectfully request allowance of the pending claims. If the Examiner believes that a telephonic interview will help speed this application toward issuance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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